

# Hunter-gatherers' coping strategies on climate change and prospect in Iramba and Mbulu Districts, Tanzania

SELEMAN SHADRACK, J. K. MWALILINO\*

Department of Physical Sciences, Sokoine University of Agriculture, Morogoro, Tanzania. Tel.: +255-23-2640021, \*email: mwalilino@suanet.ac.tz

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**Abstract.** Shadrack S, Mwalilino JK. 2022. Hunter-gatherers' coping strategies on climate change and prospect in Iramba and Mbulu Districts, Tanzania. *Intl J Trop Drylands* 6: 77-89. The study intended to establish community perceptions of climate change, assess the extent of food availability and stability, and identify Hadzabe's food insecurity coping strategies toward climate change. The study was arranged in five villages in Iramba and Mbulu Districts, Tanzania: Yaedachini, Mongo wa Mono, Kipamba, Munguli, and Domanga. Furthermore, to collect data, the cross-sectional technique was used. Next, purposive and simple random sampling was used to obtain 100 respondents. Next, data were analyzed using computer programs and content analysis methods. Finally, descriptive statistics such as frequencies and percentages were computed. This study revealed that people had experienced climate change that led to chronic food insecurity. However, the Hadzabe have developed different coping strategies to mitigate this situation. The most used coping strategies included: relying on food from the government and NGOs, migrating to the area with food, borrowing food and selling labor, eating foods that have not been used before, and engaging in petty business. In Hadzabe, the dependence on wild food and lack of food storage facilities and habits were identified as the main contributing factors to food insecurity. The study concluded that there is a need to improve the coping capacity of the Hadzabe to strengthen their coping strategies and to recognize the importance of forest resources in supporting the Hadzabes' livelihoods to improve food availability and stability. This study recommended long-term development measures such as training on crops, animal husbandry, and modern beekeeping.

**Keywords:** Climate, community, food insecurity, perception

## INTRODUCTION

Since the 1980s, it has become apparent that our planet has been undergoing significant climate change due to human activities (IPCC 2007; Srivastava and Rai 2012). Paavola (2005) has documented that climate change affects livestock distribution and productivity, the prevalence of (vector-borne) livestock diseases, and the quantity and quality of rangeland (IPCC 2007). In addition, millions of people in East Africa and the horn of Africa (Eritrea, Djibouti, Somalia, Northern Kenya, Northern, and Southern Sudan) face climate-related hunger; the shifting seasons are causing widespread hunger; a warning that could reverse 50 years of ending poverty (Agrawala et al. 2003). Tanzania has great impacts: the melting icecap and glacial retreat at Mount Kilimanjaro (Luhanga et al. 1998); experienced 1997/1998 El Niño, which led to drought and flooding, skyrocketing food prices, and the loss of crops and cattle (US National Drought Mitigation Center 1998); and destructive flood in Kilosa District in January 2010 (Daily News 2010). Tanzania will significantly impact rain-fed agriculture and food production, shorten the rainy season, increase crop losses, and reduce water availability, affecting livelihood, health, and food security (Hunter-gatherers are included). Also, the frequency and intensity of bushfires shifts in the geographic distribution of plant and land cover (Mwandosya et al. 1998), which account for 90% of total energy (Paavola 2005).

In Tanzania, three ethnic groups are categorized as

hunter-gatherers: Sanjos in Ngorongoro and Serengeti Districts, Sandawe in Kondoa District, and Hadzabe in Iramba, Mbulu, Karatu, and Meatu Districts. The societies' mode of subsistence involves hunting animals, fishing, and gathering edible plants, mobile habitat due to their reliance on a given natural environment. Their land can sustain the population densities of agriculturalists (60-100 times) more than the uncultivated hunter-gatherers (10-30 individuals). Their settlements may be temporary, permanent, or a combination. They also have non-hierarchical, egalitarian social structures; thus, wars are common and are usually caused by grudges and vendettas instead of territory or economic benefits. Archaeological and ethnographic reveal that hunting is a man's job while gathering wild fruits and vegetables for women, except for the Aeta people of the Philippines, where 85% of women hunt. They are not able to store surplus food (IDC 2007).

Hunter-gatherers (Hadzabe) comprise about 0.3% of the Iramba and Mbulu Districts; the other ethnic groups are Nyiramba, Nyaturu, Taturu, Barabaig, Sukuma, and Iraqw. Furthermore, about 90% of people living on a subsistence lifestyle in Iramba and Mbulu Districts depend on wild animals and fruits, crops, livestock, and crafts for food and income; the Hadzabe could be the most susceptible ethnic group to climate change impacts because their sustainability is highly affected by climate change (Ihucha 2008). For example, an analysis report (IDC 2007) in Munguli village reported water and food shortages that they were to eat uncommon food due to climate change

(IDC 2007).

Tanzania's regional report on livestock and harvest loss by 10% because of drought and floods. According to Ihucha (2008), hunter-gatherers face food shortages due to depending on fruit-gathering and hunting down wild animals. The prominent effect in Mbulu and Iramba includes the District's shortened and erratic rain seasons; for example, in Iramba 1984, drying of formal water sources, plant and animal diseases, and recurrent hunger were increased reported (IDC 2008). According to (MDC 2009), the Mbulu District and NGOs such as FARM-Africa are to solve the problem of food insecurity and water shortage in Yaeda valley. However, despite the government and NGOs' efforts to assist hunter-gatherers, scanty information (specifically the Hadzabe) about awareness, food availability, and act to disclose strategies used. This study is due to continuous climate change and limited information on how hunter-gatherers are affected in the Iramba and Mbulu Districts.

Several initiatives have been undertaken; policies, strategies, and programs were implemented on poverty reduction and food security. Although all the programs are solving non-hunter-gatherers problems and leaving behind Hadzabe, any effort on Hadzabe coping strategies in Iramba and Mbulu Districts will impact household food security, poverty reduction, and environmental conservation, not only generate comprehensive information, but also it would document the livelihood of Hadzabe about problems and solutions that would be useful to the government, development partners, and other relevant stakeholders in improving local coping strategies, reducing insecurity and poverty.

Specifically, the study would find out: (i) To establish Hadzabe's perceptions on climate change. (ii) To identify Hadzabe's food insecurity coping strategies toward climate change. (iii) To assess the extent of food stability and availability in Hadzabe

## MATERIALS AND METHODS

### Description of the study area and location

The study was managed in Kirumi and Haydom Divisions in Tanzania in Iramba and Mbulu District Councils (Figure 1). The study area lies between longitudes 34° and 35° and between latitudes 4° and 4°3". The study area was bordered by eight Districts as follows, to the east are Babati and Hanang, and to the north are Karatu and Meatu.

Yaedachini ward in Haydom Division and Mwangeza ward in Kirumi Division were purposively selected for this study because Hadzabe people only live in these Wards. Five villages were involved in the study, three from the Yaedachini ward and two from the Mwangeza ward. The villages are Yaedachini, Mongo wa Mono, and Domanga in the Yaedachini ward and Kipamba and Munguli in the Mwangeza ward. The ethnic group of Hadzabe is click-speaking hunter-gatherers who mainly occupy northern Tanzania, an area within the lake Eyasi basin (Madsen 2000). Their territory traditionally extends over four administrative regions: Manyara, Singida, Arusha, and Shinyanga. In recent years, in terms of numbers and density, their coverage of the Yaeda Valley and Kideru Ridge above the valley in the Iramba, Mbulu, and Karatu Districts has increased (Levin 2005).

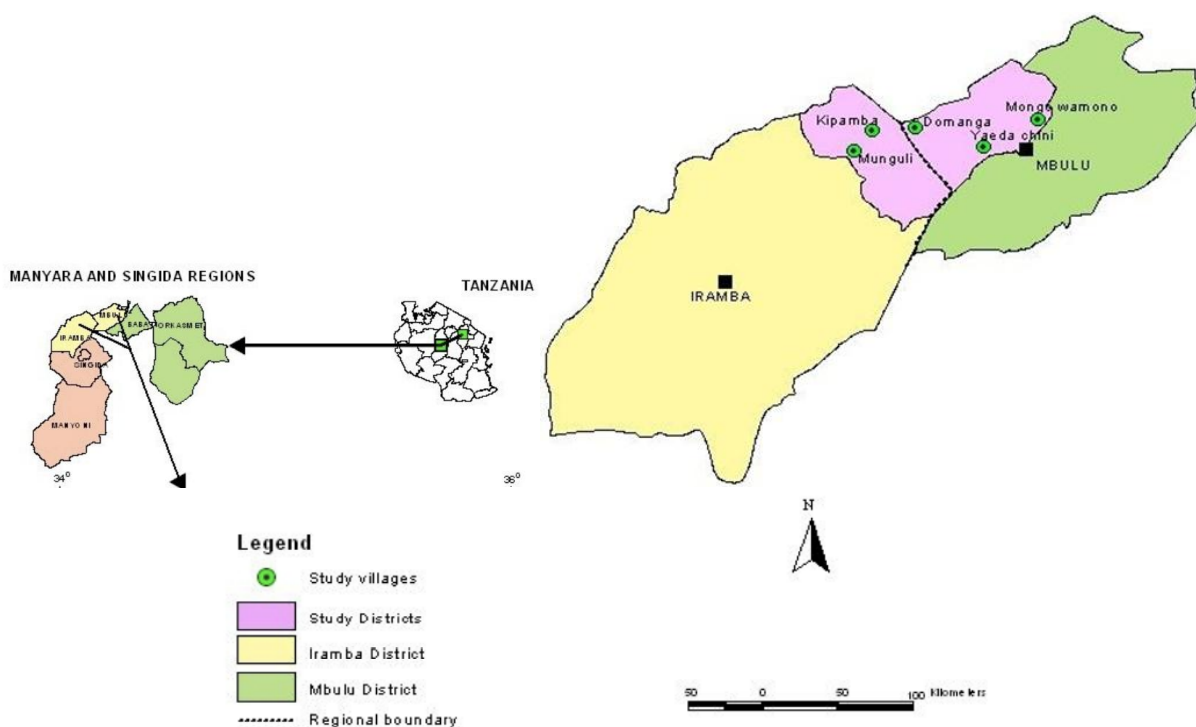


Figure 1. Map of Tanzania showing the study area

Geographically these areas have diverse landscapes. The Eyasi basin is typically semi-arid to arid with little rainfall (less than 400 mm per year), mean temperatures of 30°C, and a terrain characterized by sandy soils and rocky that are very poor for agriculture (Levin 2005). The Hadzabe population ranges between 1,300 and 1,500 people within a traditional area covers approximately 1,500 square kilometers (Madsen 2000).

### **Research design**

The method used for collecting data was a cross-sectional design. According to Babbie (1990) and Bailey (1994), a cross-sectional design could use minimum time and resources and allow data to be collected at a single point without repetitions from a sample selected representing a large population. This study's design was favorable because of limited resources like time, transport, and labor (personnel).

### **Sampling procedure**

#### *Sampling unit*

The population involved in this study was Hadzabe in Iramba and Mbulu Districts. The main target groups of the sampling unit were the head of households due to the most appropriate in assessing the society's level and standard of living (Blackwood and Lynch 1994), which provides substantial information related to the objectives of this study.

#### *Sample size*

The study sample comprised 100 respondents, and 10 key informants were used to supplement the information.

#### *Sampling method*

The purposive and Simple Random Sampling (SRS) techniques were used to get the required sample. First, the respondents were selected from the list of members using a simple random technique. Then, the purposive sampling technique was used to obtain the desirable population to obtain 5 villages, three from Mbulu District and two from Iramba District. Moreover, as it focuses directly on the study's intended area, this purposive technique has generally been recommended in social science research (Kothari 2006).

### **Data collection procedures**

#### *Primary data*

A questionnaire with open-ended questions and a checklist was used in the household survey, focus group discussion, and key informants interviews. Supplementary information, on the other hand, was collected through personal observation. The information gathered through interviews with key informants gave insights into the community-wide aspects of risks, coping strategies, and public responses to disasters.

#### *Key informant interviews*

Local and older people were involved in the research; the questions reflected perceptions of climate change and major climate change trends. In addition, there are ten key

informants interviewed for each village.

#### *Focus group discussions*

Discussions among the focus group members were held around specific topics, including coping strategies, support networks, wealth ranking, environmental changes, sources of income or support, and hunting-gathering practices. Furthermore, to express their views, the discussions allowed different groups (e.g., women, the elderly, and recent immigrants to the village). Therefore, the group of 5-6 persons was organized and considered appropriate for discussion. During wealth ranking in the study area, the communities identified three major social-economic groups based on different activities and assets. These major social-economic groups include poor, medium, and rich.

#### *Individual interviews*

Structured questionnaires and semi-structured interviews were conducted with questions relating to livelihoods, informal institutions, community interactions, and coping strategies. Informal interviews carried on between one and two hours and were usually conducted in Kiswahili language at either the village compound or the respondent's compound. In addition, several interviews were conducted using a translator from the Hadza language (language spoken by Hadzabe) to Kiswahili.

#### *Personal observations*

Observations were conducted purposely with the assistance of one experienced or knowledgeable person who understood the social settings and livelihoods performed in the village. That is a social and environmental method for understanding the distribution of households, resources, and activities undertaken. Among the aspects involved in personal observations are the types of food eaten, housing, and daily activities.

#### *Secondary data*

An extensive review of secondary data was used, especially previous studies or research and from many reports on Hadzabe in Iramba District and Mbulu District. In addition, secondary data were collected through informal discussions with staff and officials in Iramba and Mbulu Districts Council, consulting on relevant publications to the study from Sokoine University of Agriculture National Library (SNAL), and the internet.

### **Data management procedures**

#### *Data processing*

The primary data sources were summarized, edited, and then coded before entering the computer program.

#### **Data analysis**

Data analysis was done using contents analysis and Statistical Package for Social Science (SPSS) program. First, a theme wrote up notes taken during the interview for each case as part of the analysis. Next, descriptive statistics such as percentages and frequencies were described. Finally, the relations between variables pairs were determined through bivariate analysis, including cross-tabulation.

The study objectives were analyzed following analytical tools as follows: In establishing the perceptions of the community on climate change, descriptive statistics were used; descriptive statistics and cross-tabulation were used in identifying hunter-gatherers' food insecurity coping strategies toward climate change, and descriptive statistics and cross-tabulation were used in assessing the extent of food stability and availability to hunter-gatherers.

## RESULTS AND DISCUSSION

### Background variables of respondents

This section discusses the respondents' demographic background variables, including age and sex, and social factors, including marital status, education, and household size. These variables were analyzed and discussed below in the sub-sections.

### Demographic variables of the respondents

#### *Age*

The individual's age can influence productivity because the ability to conduct daily economic activities, farming and non-farming, will decrease with age. Therefore, age is the primary basis of demographic classification in vital statistics, censuses, and surveys, which is an important demographic variable (NBS 2005). The findings revealed that among the 100 respondents, the respondents ranged from 20 to 80 years old. Moreover, about 75% were particularly between 20 and 49 years old, 14% between 50 and 59 years old, and 11% between 60 and 80 years old (Table 1). According to Madulu (1996), the productive age economically ranges from 16 to 64 years old. The age groups below 16 and those above 64 are considered economically less productive due to having a high dependency ratio age structure. The ages also play a role in livelihood and coping strategies in Hadzabe village toward food security. It was reported that the age between 18-40s years old is the best age for hunting and gathering. The age above 60 was the technical age for training the young generation on hunting techniques. However, children also contributed up to 10% of collected fruits at home during fruit season.

#### *Sex*

Sex is a basic and important population characteristic for planning, labor division, and administration from household to national levels. The majority (68%) of the respondents in the Hadzabe area were males, and the remaining 32% were females (Table 1). This high male proportion was interviewed, as opposed to females, because males are heads of household in the Hadzabe tradition. The males were most likely to be interviewed, therefore, simply because the sampling unit was the head of the household, and the males were the heads even though females did many activities. As Mushi (2000) observed, the researcher aimed to interview the head of the household in cases where both a wife and a husband were available, and the husband was interviewed.

In the Hadzabe villages, the pattern of gender roles was such that women dug tubers and gathered fruits while men

mostly hunted animals and collected honey. Because of climate change, some activities which used only to be done by men are currently done by women, e.g., honey collection. On the contrary, some activities done by women are currently also taken over by men, e.g., fruit gathering. However, raising kids is still done by women for biological reasons, which Marlowe (2005a) has contended. Therefore hunting remains for men because of reduced animal availability near the homestead, and many activities conducted near the homestead are left to women.

### Socio-economic variables

#### *Education*

The education level is an important factor in coping with climate change-related disasters, particularly coping with risks and uncertainties related to food production. Regnar et al. (2002) consider the ultimate objective of education to increase labor productivity. Thus, it is a productive force for human beings and thus very important for their ability to efficiently utilize the information and advice offered by extension service providers and other development agents. The respondents' proportion with primary school education (standard 1-7) was 31%, 65% of the respondents had not gone to school, and a few (4%) of those interviewed had completed secondary school (Table 1). The study findings revealed that most households in the study area have no formal education, which is important in the fight against poverty. Any innovations uptake for issues on new technologies or good management practices will raise household resilience toward the hazard. The Hadzabe sluggishness in the study area in changing their lifestyle could be attributed to a lack of formal education among the residents.

#### *Marital status*

Marriage affects the production process as it increases labor availability in the household through sharing activities between husbands and wives and among other family members (Mtama 1997). The finding of this survey (Table 1) shows that 82% of women were married. Conversely, the entire household heads were either widowed, single, or divorced, representing 13%, 3%, and 2%, respectively. Therefore, the proportion of married respondents was greater than that of the other categories. This result seems higher than those reported by the Tanzania Demographic and Health Survey (TDHS 2005) and the National Bureau of Statistics (NBS 2005). According to those two data sources, about 66% of women in economic activities are married, lower than this finding at 82%; because family commitment implies that marriage influences daily economic activities. Moreover, as opposed to that reported by Tanzania Demographic and Survey, the high percentage of married women in the study area could be a good strategy imposed by Hadzabe to ensure that more food is brought home to cope with the food shortage. Marlowe and Berbesque (2009) reported the same result, revealed that Hadzabe, married and/or with a biological child  $\leq 8$  years old at home, takes significantly more daily kilocalories of food to camp than a single person without young biological children.

**Table 1.** Distribution of respondents according to sex and demographic variables (n=100)

Variable	Male	Percentage	Female	Percentage	Total	Percentage
<b>Age</b>						
20-29	11	11	11	11	22	22
30-39	17	17	10	10	27	27
40-49	18	18	8	8	26	26
50-59	12	12	2	2	14	14
60-69	7	7	1	1	8	8
Above 70	3	3	0	0	3	3
Total	68	68	32	32	100	100
<b>Marital status</b>						
Married	57	57	25	25	82	82
Single	3	3	0	0	3	3
Widowed	7	7	6	6	13	13
Divorced	1	1	1	1	2	2
Total	68	68	32	32	100	100
<b>Education level</b>						
None	42	42	23	23	65	65
Standard 4	4	4	3	3	7	7
Standard 7	19	19	5	5	24	24
Secondary school and above	3	3	1	1	4	4
Total	68	68	32	32	100	100

### *Household size*

A group of related or unrelated people answerable to one person referred to a household is often regarded as the household head. The household members share a residential unit or structure and have the same housekeeping arrangements (Nduwamungu 2001). The household members may be related, unrelated, or both, usually including a husband, children, the wife, and other relatives. In this research, the household size was categorized into three groups (Table 2), which are 5, between 5 and 10, and above 10 members. About 35% of the respondents had households below 5 members, 63% between 5 and 10, and 2% above 10 members. The minimum and the maximum number of people observed per household were 2 and 10, respectively (Table 2), with an average household size of 5.

The survey found the household average size is 5 members, which is relatively smaller than the figure stated in the URT (2005), at an average of 5.1 members in the Iramba District Council, while the average household size in Tanzania stands at 4.9; rapid assessment undertaken suggested that a family with more than 6 people is a big family. In addition, Nduwamungu (2001) reported a strong relationship between household size and resource exploitation because large households often over-exploit natural resources to meet their basic needs (Madulu 1996). From the study area, however, since the number of people per household is small, it was revealed that household size has no impact on Hadzabe's livelihood. So, naturally, the birth rate is very small, and no resources are over-use.

### **Establishment of perception on the observed pattern of rainfall variability**

Furthermore, group discussions and individual interviews were held to clarify the study area's perceptions of climate and climate change. The major focus of the

discussion was on how people understand and define extreme events (floods or droughts). The groups and individuals were supposed to characterize their answers. For example, bad years in terms of weather have been reported to be on the rise; the reasons given include desertification due to increased human activities (farmers and pastoralists), particularly forest clearing for the following reasons; (i) Increased grazing area (more livestock) and (ii) Expansion of agricultural activities. On the other hand, good years have decreased due to recurrent and frequent droughts. That is because the rain rarely comes on time. Furthermore, it has been stated that during the prolonged rainy season, wild-fruit disease increases, but this needs to be examined to establish the association with climate variability. Table 3 summarizes the opinions of the focus group members.

The descriptions are given in terms of good or bad years; to the Hadzabe, a good year means no severe diseases, rain is reliable, and a high number of Hadzabe coming from other villages. A good year is characterized by plenty of water and food and people having health conditions. A bad year is characterized by severe hunger, the prevalence of human diseases, and water scarcity at water points. Hadzabe is aware of rainfall variability, as shown in Table 3.

During bad years, some households sell their labor to community workers or neighboring farmers (Sukuma and Iraqw), such as building schools, roads, and agricultural activity. Also, they sell their few assets to buy food. The sold assets were mostly bicycles, radios, and goats. Moreover, it has been reported that some conflicts emerge during bad years because some people move into their area with their livestock in search of pasture land and for growing crops. That leads to conflicts between farmers and hunter-gatherers because farmers clear the bush (food reserve) for crop production.

**Table 2.** Distribution of respondents according to the village and household size (n=100)

Household size	Kipamba	Munguli	Yaedachini	Mongo wa Mono	Domanga	Total percentage
Below 5	8	9	6	7	5	35
5-10	12	11	13	12	15	63
Above 10	0	0	1	1	0	2
Total	20	20	20	20	20	100

**Table 3.** Description of good and bad years and their characteristics

Season variables	Characteristics
Good year	
Rain starts early and rains for a long time	Rain starts early and rains for a long time Vegetation/trees sprouting earlier leads to plenty of food in the jungle
Absence of water shortage	Enough water for livestock and domestic use
Absence of severe diseases	People are healthy
High number of immigrants	More food in the village
Bad year	
Severe hunger in the village	Poor, less food in the jungle
Human diseases (Malaria, typhoid)	Very hot, and much a water
Water is scarce	Low rainfall, very high temperature

**Table 4.** Trends and patterns of climatic events

Parameter	Frequency	Percentage
Perception of observed pattern of rainfall variability		
Yes	94	94
No	6	6
Total	100	100
Mentioned climate change vents within 10 Years		
Drought	89	89
Floods	11	11
The most common rainfall variation experienced		
Delay in rainy season	38	38
Early rainy season	1	1
Little rainfall	57	57
Do not know	4	4
The impact experienced from rain variation problem		
Drought	62	62
Hunger	33	33
Early food recovery	1	1
Do not know	4	4

#### Local perceptions of climate and climate change

During the discussion with Hadzabe, it was revealed that good years in climate are becoming less. Generally, extreme events occurrence and rainfall variability are more pronounced concerning the onset and cessation of the rainy season, the magnitude of drought and flood events, the number of rain days, and rainfall intensity. The results presented in Table 4 indicate that 94% of the respondents

have experienced rain-oriented problems, while 6% have not experienced any rain-related problems. In the study area, the most common rain variations experienced include delays and decreases in the rain and early rainy season. Approximately 57% of the respondents indicated decreases in rainfall per season, 38% indicated a delay in rain season, 4% did not know anything about climate change, and only 1% indicated the early onset of rains compared to past decades. However, in the study area, drought followed by the flood was specified by 89% of the respondents as a serious problem, and 11% mentioned floods (Table 4).

It was reported during the discussion that floods, as opposed to drought, have a little negative impact on Hadzabe in the study area; the reasons given are that floods increase the amount of water in the soil and water points (the place for trapping and ambushing animals). Furthermore, tubers increase in size in the uplands by their quality and quantity due to the sufficient moisture in the soil; thus, tubers can not easily shrink and become bitter during the dry season; also, the flood makes some berry trees bear fruits twice a year. The study reveals that 94% of the respondents of different sex, ages, and education levels have experienced climate change and its variability. Therefore, the household head's age, education, and sex have no significant impact on people's perception of climate change because, naturally, climate change variability to Hadzabe involves feeling and observation.

#### Description of major climatic events and their associated impacts in the study area

Based on the descriptions in Tables 3 and 4, hunter-gatherers could map out bad years in climate and the associated impacts. Table 5 shows summarize major climatic events obtained in the study area.

The most famous events that Hadzabe remembered were the great famine that occurred due to prolonged drought in 1983/1984 and heavy rainfall in 1998, which could represent the indicators of climate change in the study area. Table 5 shows the major impacts of climate change on livelihood activities, and they complained that their way of life had changed. More specifically, gathering food and hunting activities have been affected. Moreover, due to drought, wild food is increasingly becoming scarce and unpredictable, hence people's movement to other places in search of food (foraging migration). Migration is sometimes temporary since people move during bad years and come back during good years. As shown in Table 5, hunger and disease prevalence are escalated by an extreme change in the rain regime. Therefore, weather change has a big impact on hunter-gatherers' livelihoods.

**Table 5.** Major climatic events and their associated impacts in the study area

Year	Event	Impact
1983-1984	Drought	Great famine. Wild animals shifted to water points. Many people died and migrated
1998	Too much rain (El Nino)	Plenty of tubers, specifically to uplands
2002	Early rain season	Early food recovery (tubers, fruits, and honey).
2003	Drought	Hunger, people migrated to other places
2006 and 2009	Drought	Hunger influx of pastoralists and farmers to our villages often leads to conflicts.

### Major socio- economic livelihoods

Several studies have indicated that poverty levels among communities in the villages are well determined by the social or wealth status of the groups and have well-established relationships concerning livelihoods when the impacts associated with extreme events such as floods or drought occur. For example, according to Yanda et al. (2005), during a food shortage, poor people in the villages normally sell labor to the rich to sustain their livelihood in exchange for an income or a payment in kind. Therefore, in this study, the identification of different socio-economic groups per village was important to; (i) determine their vulnerability to climate change and variability and (ii) establish how different social groups cope with climate change and variability.

The main socio-economic undertakings in the study area are divided into three major groups: hunting and gathering, farm-related, and non-farm-related. All farm activities in the study area by Hadzabe were at a rudimentary stage. Thus, modern animal and crop husbandry techniques were still neglected. Table 6 indicates that 54% of the respondents were still committed to gathering and hunting, 42% were farmer-hunter-gatherers, 3% were committed to beekeeping, and 1% were working as civil servants.

Due to physical and social constraints, there have been several other non-hunting-gathering income-generating activities in the study area. Minor activities mentioned during the group discussion include petty business (kiosks and selling honey) and commitment to cultural tourism for some villages in the study area. Although cultural tourism is increasingly becoming a source of income for the community, Dorobo Safaris (Tourism Company) has established temporary camps for tourists at Mongo wa Mono and Domanga villages. At these camps, Hadzabe can exhibit their culture and take photographs with tourists on payment. Nevertheless, the tourism sector is still seasonal and affected by a low tourist flow into the village.

According to elders and village leaders, immigration is more common than emigration in the study area. The immigrants come from different places and are either

permanently or temporarily settled, depending on the cause of their migration. For example, it was revealed that Hadzabe from Karatu and Meatu Districts have been migrating to Mongo wa Mono and Kipamba villages, the reason for migrating being hunting and gathering because their former domicile areas have been changed to either game-controlled areas, tourism hunting, or other investments. The new ethnic groups, likewise, Nyisanzu, Sukuma, and Iraqw, have been coming and permanently settling in these areas for farming, which were reported as the change agent for Hadzabe culture. The Barbaig, apart from that, for many decades was cited as a native ethnic group in the study area; the difference between the two groups resides only in their livelihoods. Hadzabe is a hunter-gatherer, while Barabaig is a typical pastoralist.

### Hadzabe's wealth status

The well-being of the head of the household reflects the resilience level against food shortage in rural areas. Classifying an individual's well-being is an arbitrary exercise; therefore, it depends on criteria set by a particular community. The communities identified three major socio-economic groups based on different assets and activities in the study area. Several factors were considered in identifying the major socio-economic groups, and these include: (i) the amount of livestock a person owns (goat, sheep, or chicken); (ii) the farmland size a person owns and uses; (iii) food security situation (sustainability and amount); (iv) the types and number of the house(s) a person has; (v) the types and number assets a person has (mobile phone, bicycle, and radio); (vi) the amount of money a person has at the time. Table 7 shows that most of the population owns few resources during wealth ranking. Therefore the types of activities (Figure 2) performed and assets owned by individual households are extremely weak to cope with climate change. Weak asset resource to hunter-gatherers was explained by the fact that to keep, no anybody is either allowed to keep or eat domesticated animals because of taboo beliefs. And also, engaging in agriculture and keeping animals were reported as tedious activities compared to hunting and gathering.

**Figure 2.** A poor maize farm managed, exemplifying the poor contribution of agriculture to Hadzabe's livelihoods

**Table 6.** Distribution of activities performed in the study area (n=100)

Activity	Kipamba	Munguli	Yaedachini	Mongo wa Mono	Domanga	Total percent
Beekeeper	2	1	0	0	0	3
farmer-hunter	0	15	20	3	4	42
Hadzabe	18	3	0	17	16	54
Civil servant	0	1	0	0	0	1
Total	20	20	20	20	20	100

**Table 7.** Contemporary wealth status in the study area

Major criteria	Rich	Medium	Poor
Amount of livestock a person owns	3 goats and chicks	2 chicks	owns 0 livestock
Amount of money (Tshs.) a person has at a time	20 000	3 000	<2 000
The size of farmland a person uses	2 acres	0.5 acres of farmland	Has no farm
Food security	Has food that suffices 10 months and above in the year	Has food for sufficing for 6 months	Has food, suffice only 3 months
Number and type of house(s) a person has	Has a house made by mud bricks roofed with mud (tembe) sometimes corrugated iron sheet	Has house made of mud	Owns a house thatched entirely by grass.
Number and types of assets A person has	1 bicycle, mobile phone, and radio hand hoe	Has radio and hand hoe,	Arrows and bows

### Division of labor among Hadzabe

The Hadzabe are not territorially based, and people are free to move wherever they please, though a core group tends to rotate through the same sites. It was revealed during a group discussion that the Hadzabe men mostly hunt mammals and birds, collecting honey and fruits, while women dig tubers and gather fruits. Furthermore, it was observed that girls normally, on the nature of hunting and gathering, collect wild fruits and vegetables with their mothers. However, young boys occasionally accompany their mothers and sisters and contribute much to the family food stock. Kajembe and Munyikombo's (1998) study also reported that a big percentage of women (46%), followed by children (28%), are involved in collecting wild food, followed by men (19%). Few Hadzabe is trying to engage in agriculture, despite its poor performance (Figure 2). Since agriculture was still a new activity to Hadzabe, there was no clear division of labor.

### Status of food insecurity in the study area

Chronic food insecurity was observed in the study areas, which is a long-term or persistent food shortage; which is occurs when the Hadzabe are unable to meet their minimum food requirements over a sustained period, and it is caused by a lack of assets, an extended period of poverty, and inadequate access to financial or productive resources (FAO 2006). The food insecurity types were determined by asking the respondents about food shortages. The results in Table 8 show that 77% of the respondents frequently experience food shortages. In comparison, 22% indicated that food shortages were not happening yearly, and 1% of the respondents were food secured.

Furthermore, 76% of the respondents face food shortages between 3-5 months annually, and 16% and 8% showed food shortages between 6-7 months and 0-2

months annually, respectively. In the study area, this food insecurity could be attributed to some households having a high dependency on natural resources affected by current climate change. Conversely, the households indicated to be food secure in the study area were those whereby one of the household members is either a civil servant or the entire household is engaging in agriculture. Therefore, the above findings suggest that the population in the study area has chronic food insecurity.

Food security at the household level is affected by the composition and quality of the daily meals and the quantity and seasonal availability of staple food in the jungle. Food shortage in the study area starts in July and ends in February, the following season. Most households prone to food shortage depend solely on hunting and gathering. The mentioned months of plenty foods are March to June annually. The reason is that in March, the berries start ripening, while in May and June, honey harvesting starts and reaches its peak in July. Further reported that the honey sector was affected by climate change in two ways: the honey harvesting time is altered because of the unpredictable rainy season, and the amount of honey has declined over the past decades. The decreasing amount of honey production could be explained by the reduction in water and plant flowers which are the main honey ingredients.

### Coping strategies against food insecurity

Coping strategies are the ability of people, households, and communities to withstand adverse circumstances. Food coping strategies are divided into three categories: economical, social, and environmental. For every category, the discussion is based on Table 9.

**Table 8.** Critical months of food shortages per year in the study area

Variables	Kipamba	Munguli	Yaedachini	Mongo wa Mono	Domanga	Total percent
Months of food shortages per year						
0-2	4	1	0	0	3	8
3-5	11	19	20	9	17	76
6-7	5	0	0	11	0	16
Total	20	20	20	20	20	100
Availability of food in the jungle						
Often	19	12	6	20	20	77
Sometime	1	7	14	20	0	22
Not at all	0	1	0	0	0	1
Total	20	20	20	20	20	100

**Table 9.** Distribution of food coping strategies of hunter-gatherers toward climate change (n=100)

Coping with food shortages	52	52
Relying on food from the government, NGOs, etc.	6	6
Eating food that has not been used before		
Migrate	17	17
Food borrowing from relatives and selling labor	20	20
All of the above	1	1
Selling off some of the assets	4	4
Total	100	100

### *Social strategies*

The social response to food shortages includes labor sharing; gift or loaning food, livestock, or cash; and sometimes sending members of a distressed family to live with more fortunate friends or relatives (Zinyama 1987). Table 9 shows about 52% of the respondents reported reliance on food from the government and NGOs as a social strategy. Furthermore, the NGOs and government established a time frame indicating when hunter-gatherers become prone to food shortages yearly. Principally, the food shortage in the study area starts in December and ends in February

### *Economic strategies*

Strategies for coping with food insecurity include the diversification of economic activities regarding animal ownership, hunting and gathering, and both off-hunting and non-hunting supplements to household income. The petty business was another important coping strategy for food shortage in the off-hunting and gathering activity mentioned above. Table 9 shows the reported prominent petty businesses in the study area, which involved the sale of honey and running small shops (kiosks 10%, and selling of assets (4%). The assets sold include chicken, small ruminant animals, and cultural tools like bows and arrows, which portray their culture to tourists for payment. The Hadzabe who manage the petty business are those living with another ethnic group (farmers); for example, in Yaedachini village, the Hadzabe living with other tribes have adopted the culture of other ethnic groups. This association between non-hunter-gatherers and Hadzabe indicates that hunter-gatherer coping strategies depend on non-hunter-gatherers and therefore implies, despite the

differences in their livelihood, that it is difficult to isolate Hadzabe from other non-hunter-gatherers communities.

It was further noted that all the fruit trees in the study area were indigenous. Baobab, for example, was reported to be a source of income by hunter-gatherers, especially during the dry season. Kajembe and Munyikombo (1998) reported a similar result, which stated that wild products play a direct and indirect role in food security and that the direct role is consumption. The indirect role is selling to generate income for other expenditures.

In the context of this study, borrowing is a kind of informal food loan among households. The households with food surplus (non-Hadzabe households) give food to food-deficient ones with the expectation of repayment. In the study area, 20% were borrowed (Table 9). Borrowing is done in an agreement between Hadzabe and farmers. Depending on mutual agreement, repayment is generally done, and most of the food used to repay includes wild meat and honey.

### *Environmental strategies*

The environment in this context means forest resources and their components. In rural Africa, wild foods provide a variety of vitamins and minerals. Wild foods are important as a main or supplement in times of food scarcity and daily diet (Ngana 1983). In addition, when they are collected and sold, it would provide an opportunity to generate income. Due to climate change, in food shortages, wild foods are used as a coping strategy for rural communities.

In the study area, the Hadzabe depend on wild food; if any changes in wild food due to climate change impact their daily life. Table 9 shows that 17% of Hadzabe people were reported to have migrated to areas where there is enough wild food and 6% of the respondents reported eating wild and other foods which they have not been used to before of food due to the scarcity resulting from climate change. The Hadzabe people that migrated to the area first went to demarcated villages for the Hadzabe in Kipamba and Mongo wa mono villages. The government purposively demarcated these villages as the sole villages for Hadzabe. To stress the importance of forest resources to hunter-gatherers, Marlowe (2006) contends that the environment is a main source of food and provides about 95% of the Hadzabe. Moreover, grain food, for example, was among the mentioned food not eaten by Hadzabe for the past decades. However, the Hadzabe are forced to eat such

foods due to difficult face circumstances. Also, fishes, amphibians, immature and pregnant animals, and reptiles were not eaten when food was scarce due to customs reasons, but nowadays, these items are increasingly becoming common. While these provisions are usually eaten when there is a shortage, they demonstrate the Hadzabe coping strategies.

Age was reported to play a big role in environmental coping strategies. For example, the active age for hunting was reported to be between 18-40s years old. Hunting performed by the Hadzab could be due to the type of livelihoods, which involved long-distance scavenging for food in the jungle for those superb ages. According to Blurton et al. (1989), grouping the population into an economically active and inactive population is arbitrary; it excludes many children who participate in the family's labor force. Older people (above 40s years old, Figure 3) were reported to be important in teaching such techniques as ensnaring animals and identifying sites for hunting and gathering because of their experience. Therefore, an individual's age plays a big role and depends on environmental support.

In coping with food strategies, gender also was reported to play a big role. Although 32% of the Hadzabe interviewed (Table 1) were female, there was evidence of high responsibility of females in day-to-day household activities such as house building, children caring, collecting berries and baobab, and other foraging activities except hunting which males do. A female in the study area plays a big role in the family food collection. Nevertheless, the major determinant of gender roles is essential food accessibility in the forest.

### Livelihood activities adapted

Due to climate change, the Hadzabe, to a certain extent, have adapted to more new livelihoods now than in the late 1990s. However, it does not mean those changes on specific individuals or classes of people specializing in a particular activity. Individuals can undertake anything from hunting to gathering and farm to non-farm activities. There are several non-hunting-gathering-related incomes generating activities in the study area. Table 10 indicates that 63% of the respondents have at least participated in agriculture as a livelihood. On the other hand, 10% have engaged in petty business, 10% in livestock keeping and crop, 9% never adopted any, 7% were keeping bees, and only 1% adopted livestock keeping.

A surprising observation from the study area was that, though Hadzabe doesn't like to eat crops and grow them when there is a food shortage in the jungle, they do go out to sell their labor to nearby farmers (Iraqw and Sukuma) to get grain food for sustaining their family living. Another amazing thing is that cultivators and animal keepers surround the Hadzabe; most hunter-gatherers have, until recently, refused to take up agriculture because it would involve much hard work. When one of the Hadzabe questioned about taking agriculture as a solution to the food crisis; the response was, "When there are so many ekwa (*Vigna frutescens*) and kongolobe (*Grewia bicolor*) in the forest gifted by God, why should we plant?"

The slight changes observed from dependency on hunting and gathering to other non-hunting activities could be attributed to climate change. The other reason could be explained in the Hartmann theory, which explains "the hunter versus farmer" that most or all humans were nomadic hunter-gatherers for many thousands of years. Still, this standard gradually changed as agriculture developed in most societies, and more people worldwide became farmers. Changes in the human population, over-killing of animals, and environmental change due to human activities and climate change caused a decline in the availability of wild foods; therefore, people adapted to another way of food production (agriculture started). They expanded into lands traditionally used by Hadzabe as the number and size of agricultural societies increased. Many groups of hunter-gatherers in the world have perpetually declined partly due to pressure from growing agricultural and pastoral communities. The hunter-gatherer societies either adopted these practices or moved to other areas as a result of the competition for land use

Moreover, Hartmann speculates that the transition from hunting and gathering to agriculture is not necessarily a one-way process; people with Attention-Deficit Hyperactivity Disorder (ADHD) retained some older hunter characteristics. It has been argued (Winterhalder 1981; Marlowe 2005b) that hunting and gathering represent a coping strategy that may still be exploited if necessary; when environmental change causes extreme food stress for agriculturalists, for instance, they may also regularly hunt and gather. People in developed countries hunt primarily for leisure (Winterhalder 1981; Marlowe 2005b).



**Figure 3.** An old Hadzabe woman whose role is to teach scavenging techniques to the young generation

**Table 10.** Distribution of livelihood activities adapted by hunter-gatherers toward climate change (n=100)

Livelihood activities adapted	Respondents	Percent
Petty business	10	10
Small-size farm (0.5-2 acres)	63	63
Livestock keeping	1	1
Beekeeping	7	7
Crop and livestock	10	10
Not adopted any	9	9
Total	100	100

### Assessment of food availability and stability

The Hadzabe were asked to mention their food and rank their food preference to establish food availability and stability, regardless of how genetically or culturally influenced, are integral to maintaining an adequate diet in any particular environment (Marlowe 2006).

The most preferred food is meat, reported by 52% of the respondents; grain food 24%; wild tuber 12%; honey 9% and baobab 3%. However, their preferred food is not eaten frequently due to the seasonal nature of its availability. For example, honey is available only for 3 months annually, from April to June. Table 11 shows the accessibility of food was reported to be another source of food shortage; about 64% responded that they never ate the preferred food frequently, while 36% eating frequently were those from villages that had adopted grain food. Therefore, the poor accessibility of food could be explained because wild food is fewer, and animals have shifted to far-protected areas because of the effect of climate change.

### Food availability

Food availability addresses the supply side of food security and is determined by the food production and stock level (FAO 2006).

The observation result from the study area shows that the wild food availability has been reduced, and the reason for the reduction in amount was given. About 52% of the respondents indicated an increase in Hadzabe competing for the same resource, 37% even though the reason was less rain in the area, and 11% thought it was because of environmental degradation by farmers and livestock keepers. Figure 4 indicates that due to drought, large game animals, like buffalo and giraffes, have shifted to the protected game reserve such as the Ngorongoro

conservation area and Serengeti national park. Another reason is an increase in the human population. According to Hadzabe's custom, large animals' meat is used for paying dowry. Therefore, the unavailability of large animals has not only affected the food stability of Hadzabe but has also obliged the marriage system to change. Table 12 indicates that 40% of the respondents eat wild tuber frequently as opposed to other types of food, 19% eat baobab, 16% grain, 14% game meat, and 11% eat honey as an alternative food. The comparable percentage of food eaten as an alternative food indicates the level of food availability and accessibility to the Hadzabe. Therefore, the reason for less availability of food could be attributed to the fact that wild food is fewer and animals have shifted to far-protected areas because of water shortage in the former territory exacerbated by climate change. Wild tubers, biologically tolerant of drought, are increasingly becoming the main dish of the Hadzabe instead of meat and honey because such food items are abundant in the bush compared to other types of wild food.

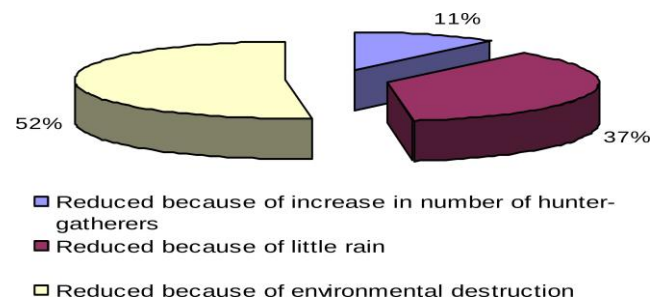


Figure 4. The main causes of food shortage in the forest

Table 11. Distribution of respondents' food preference and accessibility from gathering and non-gathering activities (n=100)

Variable	Kipamba	Munguli	Yaedachini	Mongowa Mono	Domanga	Total percent
<b>Preferred staple food</b>						
Baobab	0	0	0	1	2	3
Grain food	0	8	10	0	6	24
Wild tuber	6	0	1	1	4	12
Game meat	11	12	4	17	8	52
Honey	3	0	5	1	0	9
<b>Ability to eat the preferred food</b>						
Yes	0	17	12	2	5	36
No	20	3	8	18	15	64

Table 12. Distribution of respondents' alternative food eaten (n=100)

Alternative food eaten	Kipamba	Munguli	Yaedachini	Mongowa Mono	Domanga	Total percent
Honey	5	3	0	1	2	11
Wild tubers and berries	6	5	7	8	14	40
Baobab	3	4	3	9	0	19
Game meat	6	7	0	0	1	14
Grain food	0	1	10	2	3	16

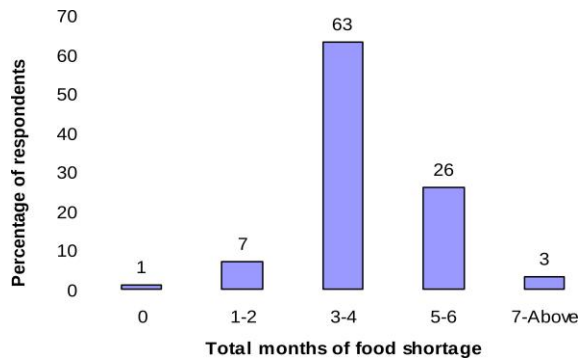


Figure 5. Level of food instability in the hunter-gatherers' area

### Food stability

Stability refers to the availability of food to all people at all times. Figure 5 shows that there was a food deficit in the study area. About 63% of the respondents faced a food shortage of between 3-4 months, 26% faced between 5-6 months, 7% faced between 1-2 months, 3% faced between 7 months and above, and 1% indicated not to have faced food shortage. Furthermore, food insufficiency was reported as a common phenomenon to the Hadzabe, which explained the instability status of food and was justified by 1% of the respondents who reported self-sufficiency.

According to FAO (2006), the main cause of food instability in the horn of Africa is the persistence of drought caused by climate change. Therefore, food instability in the study area could be accelerated by the impacts of the nature of the Hadzabe livelihoods in that they depend on hunting and gathering and climate change. As Marlowe (2006) asserts, about 80% of the food (berries, honey, and tubers) of the Hadzabe is obtained from gathering wild food and hunting, which is only 20%. Food gathering was reported to be highly affected by a change in the rain regime caused by climate change and, thus, to be seasonal biased. From March to June (berries and honey), food is plenty, while food is insufficient from August to February. Additionally, the Hadzabe, like other hunter-gatherers in the world, neither preserve nor store food for the future, and this habit demonstrates the food instability nature of the Hadzabe.

### The institutions and their roles in the study area

During interviews and discussions, important major institutions which operate in the study area were identified, as shown in Table 13. The mentioned institutions play a big role in Hadzabe's coping strategies, especially during unfavorable events. However, villages in Mbulu District are more favored by institutions than Iramba District's geographical features and position of the study area. The institutions which operate in Mbulu District are Oxfam Africa, Hay dom hospital, Dorobo safaris, Olson Company, religious institutions, and Mbulu District council. On the other hand, Iramba District reported two institutions assisting the Hadzabe in the study area: Iramba District council and Hay dom hospital. These institutions are the key players in Hadzabe's coping strategies.

Table 13. Major institutions and their roles in the study area

Institution	Major role
Olson Company (Hay dom)	Deals with the supply of food on behalf of the government during critical periods
Iramba and Mbulu District Councils	Constructing primary and secondary schools and providing food during the critical period
Religious institutions Generally	Assist in spiritual matters
Dorobo safaris	Remitting food and clothes and cultural tourism to Hadzabe

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